new low power station. Most will simply never notice. In any case, the benefit of each new LPFM station far outweighs the potential for interference.

Using results in Tables 1 and 2, it is possible to determine the average number of people who will receive LPFM coverage versus the number of people who would be affected by adjacent channel interference from LPFM stations. We computed the average population density (population per square kilometer) for the 60 cities the FCC studied in the NPRM to be 1843 people per square kilometer. We computed this value using the following method:

1. Divide the population of each city by the square area[24] of the city for population density.

2. Sum the population density of all 60 cities.

3. Divide the result by 60.

Table 3 outlines the potential audience for each type of low power station and the number of listeners who could potentially experience interference if all the conditions were just right (as discussed above), assuming an average (uniform) population density. These figures were computed by multiplying the average population density by the interference area or service area of the LPFM

[24] Population and city square area from 1990 US Census data.

station.[25] It is important to bear in mind that these values are averages, and results will vary from city to city. Also, specific propagation conditions may vary from city to city, but the standard FCC protection guidelines, when applied to the specific transmitter power levels and 30 m height above average terrain (HAAT), yield values which show an overwhelming number of citizens will benefit from LPFM as opposed to receive interference from it. It is important to realize that the number of people experiencing interference is a worst case, since many listeners may not ever receive interference, and in fact it is doubtful that all LPFM stations will use 30 m antenna heights.

Table 3. Estimate of Population Affected by and Served by LPFM Stations

LPFM Power (Watts)	Maximum Population Affected by Interference	Population Served by One LPFM Station	Percent of Those Served Who Might Experience Interference
1	48	19,536	0.24%
10	286	58,423	0.49%
100	2912	186,512	1.56%

[25] Service radii were calculated using the FCC's (50,50) curves program at 60 dBu for HAAT of 30 meters. Interference radii were calculated using the FCC's (50,10) curves program at 100 dBu for HAAT of 30 meters. The program used to find these values was http://www.fcc.gov/mmb/asd/bickel/curves.html. Area was computed using the standard formula for area: $A=\pi r^2$

5 FM Receiver Tests

Receiver studies commissioned by the Consumer Electronic Manufacturers Association (CEMA) with National Public Radio (NPR) and the National Association of Broadcasters (NAB), were conducted inappropriately and presented with unfair bias against LPFM.

In section 5.1 we find the set of receivers selected by CEMA does not match the population of receivers in use, invalidating any claim or assumption that the receiver test results represent actual FM listening.

In section 5.2 we present a method of weighting receiver results by sales and listening data. If NAB and CEMA had used this simple method, their test results would have painted a more accurate picture of the state of FM listening.

Section 5.3 covers the selection of audio quality criteria used in the NAB, CEMA and OET studies. Over half of the radios tested by NAB did not meet their own quality criteria in perfect reception conditions, throwing serious doubt on the validity of the NAB test results and the selection of the sample.

The lack of sufficient input level range for all 4 tests is explained in Section 5.4. Radios operate at a much wider input signal level range than the NAB, CEMA, OET and BSL studied them for, so the tests give us only a narrow snapshot of receiver performance.

Section 5.5 outlines the receiver test results compared to FCC protection ratios. As one would expect, a very large proportion of the tested radios does not provide as much interference protection as the FCC ratios provide. We explain why testing radios in comparison to FCC interference protection ratios completely misses the mark. CEMA and NAB certainly must know fixed and portable receivers do not need to offer interference rejection anywhere close to the overly cautious protection ratios the FCC has adopted for FM station licensing, but use this pretense as a flawed reason to claim radio receivers cannot function with LPFM.

Also in Section 5.5, we discuss why FCC separation rules for FM stations are poor predictors of overall interference conditions.

Interpretation of test results is covered in Section 5.6. Without explanation, the NAB over-counted affected population in their mapping study, indicating intent to skew results toward a predefined conclusion.

5.1 Sample Selection

Neither the NAB nor CEMA chose receivers for their sample which accurately reflect the proportions of receiver types in use.

A sample is meant to represent the entire population under consideration. When the population is very large, for practical reasons a representative sample must be chosen. If the sample is representative, fairly accurate conclusions about the population can be drawn from the results of testing the sample. If the sample is not representative, no conclusions can be drawn about the population. Moreover, selecting a biased sample can artificially produce a predetermined conclusion about the population.

In this case, a varied sample of test radios is important because FM receivers differ widely in their ability to reject interference. Less expensive radios are less able to pull stations in clearly because additional circuits are needed in the radio "front end" to accomplish very good interference rejection. Good reception at highway speeds is more difficult to engineer, so car radios cost more but reject interference very well. The tradeoff of price for performance and features is different for each receiver sales category. For example, clock radios do not need excellent sound quality at highway speeds, so they can cost less.

Neither CEMA's nor NAB's sample attempted to mimic the proportion of listening that occurs in vehicles as opposed to fixed locations. Clearly if people use one type of radio more often than another, the proportion of radios of that type in the test should be higher.[26]

5.1.1 CEMA Test Sample

CEMA is a respected authority on the market penetration of the various types of FM receivers. In choosing the sample of receivers to test, however, CEMA did

[26] BSL and OET also tested FM receivers, but did not describe their radios such that they could be placed in comparable categories. This prevented us from analyzing their samples in the same way.

not use their information on receiver types in use to make the sample representative.

CEMA says, "CEMA believes that the test receiver sample used in its laboratory testing is representative of in-use receiver designs."[27] This statement is contradicted by CEMA's own FM receiver sales figures.[28] Table 4 compares the proportion of radios in use by the public with the proportion of radios selected for the test, grouped in categories with similar uses and circuitry.

Table 4. Proportion of Radios, In Use and In the CEMA Receiver Test Sample, by Sales Category

Receiver Category	In Use (%)	CEMA Sample (%)
Table	16.8	0
Personal	24.2	6.3
Portable	21.2	18.8
Component	15.4	43.8
Auto	22.4	31.3

CEMA did not test table radios at all, yet one in six radios in use are of this type. More examples of component radios, the smallest category, were tested

[27] CEMA Study, page 17.

[28] CEMA Study, page 9-10.

than any other type.[29] Therefore this sample is not representative, and invalidates any conclusions drawn about the total population of FM receivers from the results.

One reason for the discrepancy could be that radios were chosen for particular performance measures. We believe table radios were eliminated because none could meet the test's audio quality threshold (discussed in Section 5.3). Whatever the reason, the fact that CEMA claims its sample is representative when it clearly is not suggests the test may be flawed and the results should be taken with a grain of salt.

5.1.2 NAB Test Sample

The selection of receivers used in the NAB receiver study more closely matches receivers in use, as shown in Table 5.

Without changing the total number of radios tested, NAB could have come much closer to the proportion of radios in use. If they had tested 6 Auto, 7 Personal, 6 Portable, 5 Table and 4 Component radios, the proportions would be as shown in Table 6.

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[29] The sales percentages here do not exactly match those in the table on p. 10 of the Comments. CEMA has added the sales figures for FM radios sold with vehicles to the sales of aftermarket car radios. Clearly, a more accurate picture of receivers *in use* would require ignoring the number of aftermarket car radios that simply replace the radio bought with the vehicle. We adjusted the sales figures to reflect this difference and recalculated the percentages for radios in use.

Table 5. Proportion of Radios, In Use and In the NAB Receiver Test Sample, by Sales Category

Receiver Category	In Use (%)	NAB Sample (%)
Table (clock)	16.8	17.9
Personal	24.2	17.9
Portable	21.2	17.9
Component	15.4	17.9
Auto	22.4	28.6

Table 6. Proportion of Radios, In Use Compared to a Theoretical Distribution of 28 Radios, by Sales Category

Receiver Category	In Use (%)	Theoretical Sample (%)
Table (clock)	16.8	17.9
Personal	24.2	25.0
Portable	21.2	21.4
Component	15.4	14.3
Auto	22.4	21.4

5.2 Weighting Results

Neither NAB nor CEMA weighted their results based on proportions of radios by type or proportion of time various radio types are used by listeners. Such a weighting system would have been proper and more objective. As shown below, by neglecting to weight the test results to account for the proportion of listening that occurs in vehicles NAB and CEMA over-emphasized the poor performance of radios.

No small sample of radios would perfectly reflect the proportion of radios in use. The proper procedure would be to design the sample for as close a match as possible, and then apply weighting factors to the test results to correct the remaining error.

Using sales figures supplied in CEMA's report, and their figures for car radio listening,[30] we find weighting factors by category as shown in Table 7.

Table 7. Proposed Weighting Factors for FM Receiver Test Results

Category	Weighting Factor[31]
Table	0.120
Personal	0.174
Portable	0.152
Component	0.110
Auto	0.444

Note that since car radios are listened to 44.4% of the time (and comprise 22.4% of FM radios in use), the better performance of car radios would raise the

[30] CEMA Study, pages 9-10.

[31] CEMAs listenership figures give 44.1% auto, 55.2% home. These do not add up to 100%, so we added half the difference to each proportion for 44.4% and 55.6%. We found the percentage of non-auto radio sales, and multiplied by 0.556 to obtain the weighting factors for each non-auto category. This assumes people listen to each category of non-auto radios equally. While these weighting factors do not represent reality perfectly, we believe that using them will paint a more accurate picture of FM radio use by the public.

overall performance of radios if the measurement data were weighted by sales and listening data. This was not done.

5.2.1 NAB Mapping Study

The NAB's mapping study of potential LPFM interference completely left out automobile radios from consideration. Including auto radios would have shown that LPFM would have a much smaller impact on interference than the NAB claims.

After conducting their receiver tests, the NAB examined the size of potential LPFM interference areas in a mapping study. A fair evaluation would have employed the receiver test results weighted for sales and listenership by category. Instead, the NAB excluded car radios from the mapping study entirely. This skews their sample away from representing the population of FM radios to a tremendous degree, utterly destroying any hope of applying the results to FM listening as it exists today.

The NAB gives three reasons for excluding automobile radios from their mapping analysis of potential LPFM interference.[32] We address each in turn:

1. Car radios perform better than FCC protection ratios would assume.

[32] NAB Study, Volume 3, "Interference From Low Power FM Stations to Existing Stations", p. 10.

Auto radios account for over 20% of all radios in use. Car radios are in use for 44% of all listening to FM radio. Eliminating them for good performance indicates a clear intent to slant the report toward a pre-decided conclusion. Even if the car radio interference contours are small on the maps, their inclusion is essential because the tabular analysis is derived from the mapping calculations. Without car radios, the tabular analysis of affected population is inaccurate.

2. Any interference areas for car radios would be contained within interference areas for other types of radios.

This reason applies to all radios. Because signal power, and therefore interference levels, fall off with increasing distance, the interference areas for each type of radio are contained within that of the next-worse radio. For example, the interference area for Home/Stereo radios is entirely inside the interference area for Clock & Personal radios. *All* the interference areas are nested. Nested interference areas cannot be a valid reason for excluding any particular radio category.

3. The objective of the study is to determine the impact that relaxing the existing Commission protection ratios would have.

NAB's third reason has nothing to do with car radios. Relaxed protection ratios could affect all radios.

5.3 Selection of Quality Criteria

We do not believe the quality criteria selected for the recent FM receiver tests were formulated with enough objective rigor to offer sufficient input to any FM regulatory process.

In this section we discuss two criteria for evaluating audio quality: signal to noise ratio (SNR) and distortion. Section 5.3.1 critiques specific SNR thresholds chosen by CEMA and NAB. Section 5.3.2 discusses inherent difficulties in selecting a specific SNR threshold at all.

Testing FM receivers for interference rejection requires a quantitative measurement of the audio quality produced under various interference conditions. Two measurements are normally used: signal to noise ratio and distortion.

To enable comparison from one receiver to the next, a threshold of audio quality is needed. All receivers in the test are "stressed" with interference until the measured audio quality drops to the threshold. The threshold may be defined in terms of SNR or distortion.

We compare the 4 receiver test samples for this threshold in Section 5.3.1 and note that many more of NAB's radios failed. In fact, NAB chose a quality criterion threshold that was impossible for 54% of its tested receivers to meet. This suggests that either the performance metric was unrealistic, or that there was an intentional effort made to select inferior radios.

All of CEMA's receivers were able to meet the quality threshold they chose. By comparison to the other receiver test samples, this may mean that CEMA pre-selected receivers as well, but for different reasons. A desire for a valid test procedure may have driven CEMA's selection, yet it ruined any chance of the sample accurately representing the population of FM radios.

None of the radio studies used the common quality criteria value for radio troubleshooting (40 dB SNR). This is a widely known and used threshold for quality in the technical end of the radio business. Why NAB or CEMA never mentions it is unexplained.

OET tested for a 1% or 3% rise in distortion. This is very different from setting a predetermined threshold for quality and then testing a radio against it. This method allows testing of radios in a wide range of quality levels, without concern as to whether they will meet the threshold in the presence of no interference. As such, this method would have helped CEMA avoid the temptation of handpicking radios for testing.

5.3.1 Signal to Noise Ratio

Both CEMA and NAB chose quality standards by which to test FM receivers that can never be achieved by a sizeable proportion of existing radios.

One of the principle ways to characterize audio quality is to measure the relative volume of the desired sound to the noise. Noise manifests itself as hissing or static behind the program audio. No audio system is completely immune from noise, but analog radio systems are particularly susceptible to bothersome noise levels.

Signal to noise ratio (SNR) is measured in decibels (dB), a logarithmic way of expressing the difference of two numbers which is convenient for quantities with wide ranges. For example, the power ratio 1/10000 or 0.0001 is equal to -40 dB.

A higher S/N number indicates better audio quality (the noise is much lower in volume than the program audio). A lower S/N means noisier-sounding audio.

The NAB used 50 dB S/N for the standard threshold of FM reception quality.[33] By choosing this standard, the NAB required the acoustic power of the program audio to be greater than that of the noise by a factor of 100,000 in order for a radio's reception to be considered acceptable. This is an extraordinarily high standard for sound quality from FM broadcasts.

Table 8 summarizes the noise performance of radios in perfect reception conditions (no interference) from the four recent FM receiver tests.

Over half the radios chosen by the NAB did not meet the 50 dB signal to noise ratio criteria for acceptable audio quality in perfect reception conditions with zero interference. If the samples were all representative in terms of radio quality, we would expect about the same proportion to fail *any* given audio quality threshold. Table 8 seems to demonstrate that NAB chose a larger proportion of poor quality receivers to include in their test sample.

Table 8. Proportion of FM Radios in Each Test Sample That Could Never Produce 50 dB S/N on Audio.

Tester	Radios with < 50 dB S/N[34]	Total Radios Tested	Failure Rate
NAB	15[35]	28	54%
BSL	2[36]	11	18%
OET	6[37]	21	29%
CEMA	3[38]	16	19%
Overall	26	76	34%

[33] "Standard of Service for FM Receiver Tests In Support of the Comments of The National Association of Broadcasters MM Docket No. 99-25", July 21, 1999, pages 6-10.

[34] For NAB and BSL: As measured with a desired signal level at or near –55 dBm, which is approximately the level expected at the edge of the 60 dBu protected service contour of most FM stations. The CEMA test recorded a "best S/N" without test details, so the input desired signal level is unknown. For OET: from the quieting levels they recorded in characterizing their radio sample.

[35] "FM Receiver Interference Test Results Report", Pepared for: the National Association of Broadcasters, NAB Study Volume 2, August 2, 1999, page 24.

[36] "National Lawyers Guild Committee on Democratic Communications Receiver Evaluation Project", June 30, 1999, by Broadcast Signal Labs, LLP, Appendix G.

[37] "Second and Third Adjacent Channel Interference Study of FM Broadcast Receivers", Project TRB-99-3 Interim Report, July 19, 1999, Technical Research Branch, Laboratory Division, Office of Engineering and Technology, Federal Communications Commission, p. 4.

[38] "FM Receiver Interference Tests, Laboratory Test Report", RMC Technologies for National Public Radio, Consumer Electronics Manufacturers Association and Corporation for Public Broadcasting, July 27, 1999, Appendix B, page 1.

For the purposes of their test, CEMA adopted an earlier suggestion from a National Public Radio (NPR) report that the reference quality level be 45 dB SNR on audio.[39] Table 9 shows how well the tested radios fared against this standard.

Table 9. Proportion of FM Radios in Each Test Sample That Could Never Produce 45 dB S/N on Audio.

Tester	Radios with < 45 dB S/N[40]	Total Radios Tested	Failure Rate
NAB	11[41]	28	39%
BSL	1[42]	11	9%
OET	6[43]	21	29%
CEMA	0[44]	16	0%
Overall	18	76	24%

Only CEMA's sample met the "45 dB S/N without interference" specification universally. Since only CEMA was concerned with 45 dB S/N performance, we

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39 "Comments of the Consumer Electronics Marketing Association", p. 10.

40 For NAB and BSL: As measured with a desired signal level at or near –55 dBm, which is approximately the level expected at the edge of the 60 dBu protected service contour of most FM stations. The CEMA Study recorded a "best S/N" without test details, so the input desired signal level is unknown. For OET: from the quieting levels they recorded in characterizing their radio sample.

41 See note 16.

42 See note 17.

43 See note 18.

44 See note 19.

believe they chose only receivers which could provide that level of audio quality or better. That may explain why they tested no table radios – perhaps none could be found that met their stringent quality criteria.

Typically in a receiver study, if a fixed quality threshold is chosen, the radios should meet the quality criteria before interference is applied. On the other hand, no conclusion can be drawn from a technically accurate test of a non-representative sample of radios.

Over half the radios tested by NAB failed to meet their own quality criteria at the outset. For the radios that could not meet the quality threshold in the no-interference condition, NAB tested for a 5 dB decrease in SNR. Because they used two different testing methods, NAB should have reported the test results for each subset of radios separately. Or, NAB could have chosen to test all receivers for a 5 dB decrease in SNR. The fact that they held onto the 50 dB SNR threshold wherever possible indicates it had an importance to them outside it's utility as a test benchmark.

Unfortunately, none of the radio receiver tests used a lower SNR threshold, say 40 dB SNR or 38 dB SNR, which was achievable by all measured radios. By using a benchmark that was common, it would have been possible to consider a reasonable "go, no-go" threshold for deciding whether a given receiver is functioning properly.

The above observations illustrate the problems with choosing a fixed quality threshold for radio testing. BSL avoided these problems by testing radios at fixed D/U ratios and recording both SNR and distortion, hoping to find a general D/U at which radios began to fail rapidly. OET chose to test for a 1% and 3% rise in distortion, starting at whatever distortion the radio could produce in perfect reception conditions. With these methods, the question of how many receivers are capable of meeting the quality threshold does not arise.

5.3.2 Choice of Quality Standard

Choosing a fixed audio quality threshold creates testing or sampling problems, as outlined in Section 5.3.1. To arrange for all receivers to meet the threshold in perfect reception conditions, the sample or the threshold must be adjusted. Tweaking the sample removes any hope of applying the test results to the entire population of receivers. Picking a threshold slightly below the quality level of the worst receiver in the sample (measured in a no-interference situation) brings with it no troublesome consequences for sampling validity or test objectivity.

Rather than choose a fixed quality threshold, defining the extent of the change in audio quality for a given change in interference levels or ratios is a far more objective approach to radio testing. This is what OET did, and what NAB did for the radios in their sample that failed to meet the 50 dB S/N on audio with no interference. Unfortunately, mixing methods within the same test prevents comparing the results from radios tested in different ways. In choosing a fixed threshold, NAB and CEMA created testing problems for themselves that were not solved to our satisfaction. In an academic setting, the design of NAB's and CEMA's tests would be considered flawed and the results from such tests would be disregarded.

5.4 Range of Desired Input Levels

None of the four receiver tests repeated their procedures for a wide variety of desired input signal levels. Receivers cannot be accurately characterized without this step. The tests do not give a complete picture of receiver performance in the real world.

Radio receiver performance varies widely with input signal levels. Thoroughly testing receivers for susceptibility to interference requires repeating the procedures with a wide range of desired signal input levels and for a few different output levels. For FM reception, an acceptable input signal range would be 0 to –90 dBm, and output SNR levels of 40 dB and 45 dB.

Each of the four receiver testing organizations applied a desired signal at different levels. Table 10 summarizes these levels.

The NAB's test properly attempted to examine the effects of a range of input signal levels, but did not employ a wide enough range of input levels to determine anything more than a vague trend, particularly given the fact they used an output metric (50 dB SNR) which was not achievable in more than half of their test sample.

Table 10. Desired Signal Levels at Which FM Receivers Were Tested

Testing Organization	Desired Signal Level(s) In dBu at 100 MHz	Desired Signal Level(s) In dBm
BSL	61	-54
OET	58	-57
NAB	50, 60, 70	-65, -55, -45
CEMA	65, 45	-50, -70

Though touted as complete and representative receiver tests, we consider the lack of a common output metric and the narrow range of input levels used to be problematic.

A more complete test from which better conclusions could be drawn would have used several different input signal levels (i.e. 0 dBm to –90 dBm) and two output SNR levels (i.e. 40 dB and 45 dB).

NAB uses their receiver test results to generalize that "...the interference susceptibility of contemporary receivers has generally not improved since the (FCC) rules were adopted in the 1940's."[45] However, the lack of a limited range

[45] "Selection of Receivers for FM Receiver Testing and Analysis of Test Results In Support of the Comments of the National Association of Broadcasters in MM Docket 99-25", Moffet, Larson & Johnson, Inc., July 21, 1999, page 16.

of input signal levels (among other test problems) prevents any accurate generalization.

5.5 Receiver Performance Compared to FCC Interference Regulations

By testing FM receivers against the FCC protection ratios, CEMA and NAB posited that FM receivers should perform as well as assumed by the FCC protection ratios governing radio station licensure. Holding the performance of modern FM receivers to the FCC protection ratio standard completely misrepresents the purpose of the FCC interference protection ratios, and could be an attempt to deceive the public about FM reception conditions. The FCC protection ratios were designed to provide simple and conservative spacings to prevent early FM radio receivers from undesired retuning to strong adjacent stations.

Reasonably, a large proportion of CEMA's and NAB's tested receivers did not perform as well as the FCC interference protection ratios would predict. The FCC protection ratios were designed around early FM radios and the RF filtering and frequency synthesis available at that time. Early FM receivers tended to retune themselves to a strong adjacent channel signal. Today's FM receivers have never needed to perform as well as the FCC ratios would predict because modern radios resist adjacent signals better than older radios. In fact, a commercial FM receiver designed using the FCC protection ratios would produce an extremely expensive radio, far beyond the needs of FM radio consumers.

While it's difficult to compare the different receiver studies, they demonstrate car radios are much more robust to interference, and are typically designed to come close to the FCC 2^{nd} and 3^{rd} adjacent protection ratios (D/U = -40 dB), whereas all other types of FM receivers can be designed much less stringently. Manufacturers design car radios with better adjacent filtering capabilities because of signal fading and the ability to travel arbitrarily close to an interfering broadcaster – if an interference signal rises while the desired signal level dips, a poorly designed receiver will have unintelligible output, whereas a well designed receiver will still be able to detect the desired signal. No such interference protection buffer is needed for household FM receivers because they do not experience severe fading nor move rapidly towards an interfering station.

FCC protection ratios do not reflect the actual FM interference environment. In fact, the interference environment is much more forgiving than the FCC ratios would indicate, which is why modern receivers are designed less stringently than the ratios indicate. The FCC ratios are the basis for a conservative calculation of the required separation distances for FM stations. Thus, the ratios tell us how close FM stations can be to each other, but very little about the actual resulting interference.

The spacing of new FM stations is governed by multiple separation rules, in such a way that the most stringent rule (i.e. the most rigorous co-channel or adjacent protection ratio) predominates. This means for a given adjacency, just a few pairs of potentially interfering stations are as close together as the rules would allow. Therefore in most cases the interference is much less than the FCC ratios would indicate.

In the receiver tests, the proportion of receivers that failed to perform as well as FCC ratios for 2nd and 3rd adjacent channel interference would predict is quite revealing. Clearly, the FCC protection ratios and/or the chosen quality thresholds have no bearing on real world receiver performance. Table 11 shows the percent of radios in each category of the CEMA and NAB tests that could not receive a signal with a D/U of –40 dB and output audio with 50 or 45 dB S/N. In other words, the radios tallied here could not receive a signal of acceptable quality (as defined by the tester) in the presence of the FCC protection ratio level of interference.

Table 11. Proportion of FM Receivers Unable to Meet Quality Thresholds at FCC Protection Ratios

Category	CEMA 2nd Adj.	NAB 2nd Adj.	NAB 3rd Adj.
Automobile	60%	38%	38%
Component	100%	80%	80%
Personal	100%	100%	80%
Portable	100%	100%	100%
Table	100%	100%	100%

For comparison, between 10 and 29% of OET's radios performed worse than FCC protection ratios, albeit using a 1% rise in distortion as the audio quality threshold. (BSL did not test their receivers in a comparable way.)

In other words, in an interference scenario where the radios under test must successfully reject an undesired 2nd or 3rd adjacent signal which is 10,000 times as strong as the desired on-channel signal, nearly all the radios tested could not meet the stated quality threshold. The tests reveal commercial household radios are not built to reject a level of adjacent channel interference anywhere close to the FCC station protection ratios. Obviously the same radios are successfully sold to the public, so clearly there is no need for receivers to have anywhere close to this level of interference rejection in the real-world environment.

In the receiver tests, the FCC station licensing procedure's rules were assumed to reflect the actual FM reception environment. This is a flawed assumption, because it is clear that there is a huge discrepancy between FCC protection guidelines for FM station licensing, and the real-world interference rejection requirements of household FM receivers. We believe a combination of factors leads to this result.

First, the FCC interference protection guidelines stem from the need to avoid strong adjacent channel signals, so that the early generation FM radios would remain tuned to the desired station. Assuming the receiver remains locked to the desired station, the prescribed signal strength ratios are much greater than are actually required for good quality reception using modern FM receivers. The receiver studies indicate modern FM receivers may operate properly with much less adjacent channel interference filtering.

Second, and most important, the FCC protection ratios do not represent the actual interference environment for FM receivers. FM stations must be spaced at least as far apart as the specified separation distances given in Part 73, but practical matters and conservative margins for fading and interference in the FCC's propagation model ensure that radio stations are more widely spaced than necessary for virtually all potential interference cases. This is a key result of the receiver studies and shows that the FCC can eliminate some interference protection requirements for LPFM radio service.

5.6 Specific Biased Errors in NAB's Interpretation of Its Results

In the following sections we discuss evidence of a non-objective approach taken by the NAB in estimating the impact of LPFM. In particular:

1. In the tabular analysis of their mapping study (contained in NAB Study, Volume 3) the NAB seriously over-counted the number of people affected by potential LPFM interference.

2. The NAB mapping study was so poorly documented that reviewers cannot reproduce their results.